1

Chapter 5 - Cisco

* LANs
- ethernet, token ring, FDDI (fiber distributed data interface)
- ethernet - UTP
- token ring - STP
- FDDI - multimode fiber
* Ethernet
- Digital, Intel & Xerox started it
- 9 types of Ethernet
- most common is Ethernet 2
- 802.3 defines CSMA/CD
- CSMA/CD - carrier sense multiple access with collision detection
* Cabling
- EIA/TIA defines RJ-45 for UTP
* Cable uses
- straight-through - switch to router
  switch to PC
  hub to PC
- crossover - PC-PC
  PC - hub
  hub - hub
  router - router
  PC - PC
  router - PC
- console (rollover) PC - router (terminal session)

* Devices
- repeaters - hubs - switches - routers
* Repeaters
- retimes and regens signal
- extend cable
- large 1 device
- cannot filter traffic
- deal with bits
- increases number of nodes on network
- (5-4-3 rule) (2-1)
- (5 segments max - 4 repeaters - 3 only have users)
- repeaters are dumb
- (2-1) two are linking states, 1 collision domain
* Hubs
- multiport repeater
- sends out on all ports
- active & passive
- active - power, retimes & reshapes
- passive - no power, sends to all ports, but no reshaping
- used to be a concentrator (to make star topologies)
- one large collision domain
- the more ports, the more computers, the slower the network
- intelligent hubs - smart hubs, not switches or bridges, able to determine if data has error
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Ch. 6 - Cisco

* Intro to Ethernet
- started by DIX
- CSMA/CD - carrier sense multiple access with collision detection
- CS means NIC listens to network to see if traffic is on it
- MA - many computers on same wire
- CD - when transmitting, it listens for collision
- 802.3 - defines 10Mbit Ethernet
- IEEE - internation electrical & electronics engineering
- now Ethernet is Ethernet 2
- frame starts with start bits - source MAC, dMAC, data, checksum
- 802.3a - 100 Mbit
- 802.3ab - 1000 Mbit
- 802.3z - 1000 Mbit on fiber
- legacy Ethernet - 10 Mbit
- fast Ethernet - 100 Mbit
- gigabit Ethernet - 1000 Mbit
- Ethernet is on physical and bottom layer of data link
- repeaters extend collision domain
* Ethernet & OSI model
- 802.5 - token ring
- layer 1 - wires and hubs, signals, connectors, twists, speed
- layer 2 - frame format and addressing
- bottom half in layer 2 is MAC
- MAC listens for collisions, supplies physical address
- LLC is defined by 802.2
-

* Naming
- MAC is 6 bytes long
- OUI is first 3, serial number is last 3
- always in hex
* Frames
- start sequence, sMAC, dMAC, type/length of frame, data field, frame check sequence
- CRC - cyclic redundancy check
- parity check
- CRC -
- 2d parity - horizontal & vertical parity checks
- internet checksum - MTU - how long packet is
- 802.3 frame & Ethernet 2 frame isn't the same
- also SNAP & SAP (thanks to Novell)
* Frame Field
- preamble - frame is on way
- dMAC
- sMAC
- length of frame (802.3 only)
- frame check sequence

Ch. 6

* MAC
- media access control
- MAC layer allow interface with medium
- deterministic - token ring & FDDI
- non-d - ethernet
- ethernet is logical bus
- FDDI - logical ring, physical dual ring

* CSMA/CD
- carrier sense - everyone listens
- multiple access - more than 1 can transmit
- collision detection - listens for collision
- jam signal - destroys collision data & sets timers back

* Ethernet timing
- 10 Mbps - 100 ns
- 100 Mbps - 10 ns
- 1000 Mbps - 1 ns
- 10000 Mbps - .1 ns

} bit times - time it takes to put another station wire

* Interframe Spacing
- 96 bit time between 1 frame & another
- slot time parameter - 512 bit times, how long it should wait to send data to reduce collisions

* Error handling
- collision - jam signal - timer reset
- early - occurs on segment you are on
- late - assumes frame got there, doesn't resend, different segment

* Types of collision
  - late - occurs after header
  = remote - different segment
  - frame headers are 64 octets
  - runt - piece of a frame less than 64 octets
  - jabber - long frame
* Ethernet errors
  - alignment error - if length is short or big -
  - range - if octets
* FCS
  = DIX doesn't have start or length part
* Auto negotiation
  - 16 ms - pulse a signal to tell its capability
* Half & full
  - half duplex - transmit OR receive
  - full duplex - transmit on 1 & 2, receive on 3 & 6

Ch. 8 - Cisco

* Bridging & Switching
- CAM - content addressable memory
- CAM keeps table of MACs
- cut-through - fast forward & fragment free
- STP - spanning tree protocol
* Layer 2 switching
- switch maintains CAM
- ASIC - application specific integrated circuit
- ASIC are chips designed for one function
- hardware is now used more than software
* Latency
- time frame starts to leave source to beginning of destination
- delays of wire, circuitry, or software
* Switching Modes
- cut-through - part of fast forward, frame is read by switch for DA/MAC and then sent, doesn't check for anything
- fragment-free - gets first 64 bytes, part of fast forward, gets minimum 64 bits for a frame and then sends it on
- store-and-forward - brings in all of frame, checks for FCS error, then passes it on
* (A) synchronous modes
- async - data speeds can vary, use store and forward
- sync - where ports are same speed, can used cut-through
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* Spanning Tree Protocol
- when switch detects port as disable, it sends over another line
- sends BPDUs
- redundant path creates switching loops
- BPDU, are used by switches only
- STA processes info and shuts down ports
* States of STP
- blocking - sends BPDU, allows switch to come in
- listening - listens for other traffic on network
- learning - learns where devices are on ports
- forwarding - starts forwarding frames
- disabled -
- blocking to listening or disabled
- no on down list
* Collision Domain
- more collisions, slower network
- jam signals, backoff, etc...
* Segmentation
- layer 2 devices make more collision domains
- layer 3 devices do not forward collisions
* Broadcast domains
- switches broadcast
- all devices must respond to it
- routers make more broadcast domains
- broadcast radiation - too many broadcasts

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* ARP
  - address resolution protocol
  - workstation broadcast ARP to find MAC of another computer
  - DNS - name to IP
  - ARP - IP to MAC
  - ARP table keeps track up to 2 hours
* Routing Protocols
  - increase broadcast traffic
  - RIV1 uses broadcast and sends every 30 secs
* Broadcast Domains
  - broadcast domain broken up by layer 3
* Network Segment
  - pretty much a broadcast domain
  - broken up by broadcast domain
  -

Ch. 9 – Cisco

* Origins
  - came from DoD
* Layers
  - only 4
* Transport Layer
  - TCP/UDP
  - TCP - connection
  - UDP - connectionless
  - sliding window - allow comps to talk about how they're handling data
  - window can change at any time
* Internet layer
  - sequence & acknowledge
  - SYN/ACK
  - IP - internet protocol
  - ICMP - ping & traceroute
  - ARP - IP based
  - RARP - IP based
* Network access Layer
  - PPP, SLIP, ATM, Proxy ARP, ARP, RARP
  -

Ch. 9 - Cisco

254 - FE

* IP Addressing
  - IPv4 - dotted decimal
  - IPv6 - nightmare
  - path selection
  - tracert & ping
* IPv4
  - classful addresses
  - A - very large networks
  - B - large / schools / ISP
  - C - small
  - D - multicasts
  - E - research only
  - 4 byte decimal coded binary
* Classes Range
  - 0.0.0.0 - 127.255.255.255 A
  - 128.0.0.0 - 191.255.255.255 B
  - 192.0.0.0 - 223.255.255.255 C
  - 224.0.0.0 - 240.255.255.255 D
  - 241.0.0.0 - 255.255.255.254 E
* Network / Host
  - A - N.H.H.H
  - B - N.N.H.H
  - C - N.N.N.H
  - 141.16.0.0 - Network address for 141.16.8.223

* Bit Classes
- $0_{xxxxxxx}$ - A
- 10_{xxxxxx} - B
- 110_{xxxxx} - C
- 1110_{xxxx} - D
- 1111_{xxxx} - E

* Subnet Mask
- standard for A - 255.0.0.0
  B - 255.255.0.0
  C - 255.255.255.0

* Private Networks
- not routable on internet
- 10.0.0.0 - 10.255.255.255 - A
- 172.16.0.0 - 172.31.255.255 - B
- 192.168.0.0 - 192.168.255.255 - C
- 127.0.0.1 - 127.255.255.255 - reserved
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Ch. 10 - Cisco

* Routing
- forwarding packets based on logical address
- routers break up networks
- routing protocol - between routers
- routed protocol - between hosts
* Protocols
- OSPF
- RIPv1, RIPv2
- IGRP, EIGRP
- each builds tables to tell where networks are
* RIP
- v1 requires classful routing
- classful - uses classes (routing with class) (doesn't know about subnet)
- v1 sends only network
- OSPF, EIGRP - classless
- v2 is classless
* Routing tables
- net interface metric
- bandwidth, load, delay, reliability, hop count

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* Layer 3
  - move data through network
* Path Determination
  - router only knows a few others
* Packets
  - sIP is before dIP, unlike frame (dMAC - sMAC)
* IP header
  - VERS - 4 bytes

Ch. 11 - Cisco

* TCP/IP Transport Layer
  - TCP - connection oriented, reliable
  - UDP - connectionless, unreliable
  - does segmenting
  - makes host to host
  - flow control & reliability
* Segments - TCP
  - sPORT / dPORT
  - frames re d/s
  - SYN #
  - ACK #
  - sliding window - flow control
  - checksum
  - padding
* Segments - UDP
  - sPORT
  - dPORT
  - length
  - checksum
  - data
* TCP Session
  - A B

    seq x ——→ ack x+1

    ack y ←—— seq y
  - PAR - positive acknowledgement & retransmission

* DNS
- .us - US
- .uk - UK
- .edu - education
- .net - ISP
* HTTP
- http:// - protocol
- www - hostname of server
- name
- domain
- folder on server
* SMTP
- email

Network Math

- Class A - 0_{xxxxxx} 0.0.0.0 → 127.255.255.255
  B = 10_{xxxxxx} 128.0.0.0 → 191.255.255.255
  C = 110_{xxxx} 192.0.0.0 → 223.255.255.255

* Subnet Mask

- 152.173.19.12 10011000.173.19.12) and
  255.0.0.0 subnet 11111111 0.0.0)
  152.0.0.0 10011000.0.0.0
- 152.173.19.12 10011000.10101101.19.12
  255.192.0.0 11111111.11000000.0.0
  255.128.0.0 10011000.10000000.0.0

Ming	Me		kirk		Jon
1	2	3	4	5	6
100	100	100	200	100	200
300	500	0	500	0	0
900	500	0	0	0	0
300	900	300	0	0	0
300	300	0	0	0	0